AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (CURRENTLY AMENDED) A pitch analysis device for producing a set of pitch codebook parameters, comprising:

a pitch codebook search device configured to generate a pitch code vector based on a digitized input audio data, wherein said digitized input audio data represents an input audio signal that has been sampled and digitized;

a) at least two signal paths associated to respective sets of pitch codebook parameters representative of said digitized input audio data, wherein:

i) each signal path comprises a pitch prediction error calculating device for calculating a pitch prediction error of ~~a~~ said pitch codevector from ~~a~~ said pitch codebook search device; and

ii) at least one of said at least two signal paths comprises a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of said at least one signal path; and

b) a selector for comparing the pitch prediction errors calculated in said at least two signal paths, for choosing the signal path having the lowest calculated pitch prediction error and for selecting the set of pitch codebook parameters associated to the chosen signal path.

2. (PREVIOUSLY PRESENTED) A pitch analysis device as defined in claim 1, wherein one of said at least two signal paths comprises no filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device.

3. (PREVIOUSLY PRESENTED) A pitch analysis device as defined in claim 1, wherein said signal paths comprise a plurality of signal paths each provided with a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of the same signal path.

4. (PREVIOUSLY PRESENTED) A pitch analysis device as defined in claim 3, wherein the filters of said plurality of signal paths are selected from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

5. (ORIGINAL) A pitch analysis device as defined in claim 1, wherein each pitch prediction error calculating device comprises:

a) a convolution unit for convolving the pitch codevector with a weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) a pitch gain calculator for calculating a pitch gain in response to the convolved pitch codevector and a pitch search target vector;

c) an amplifier for multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) a combiner circuit for combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

6. (ORIGINAL) A pitch analysis device as defined in claim 5, wherein said pitch gain calculator comprises a means for calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

7. (ORIGINAL) A pitch analysis device as defined in claim 1, wherein said pitch prediction error calculating device of each signal path comprises means for calculating an energy of the corresponding pitch prediction error, and wherein said selector comprises means for comparing the energies of said

pitch prediction errors of the different signal paths and for choosing as the signal path having the lowest calculated pitch prediction error the signal path having the lowest calculated energy of the pitch prediction error.

8. (ORIGINAL) A pitch analysis device as defined in claim 5, wherein:

a) each of said filters of the plurality of signal paths is identified by a filter index;

b) said pitch codevector is identified by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

9. (ORIGINAL) A pitch analysis device as defined in claim 1, wherein said filter is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.

10. (CURRENTLY AMENDED) A pitch analysis method for producing a set of pitch codebook parameters, comprising:

generating a pitch code vector from a pitch codebook search device based on a digitized input audio data, wherein said digitized input audio data represents an input audio signal that has been sampled and digitized;

a) in at least two signal paths associated to respective sets of pitch codebook parameters representative of said digitized input audio data, calculating, for each signal path, a pitch prediction error of ~~a~~ said pitch codevector from ~~a~~ said pitch codebook search device;

b) in at least one of said at least two signal paths, filtering the pitch codevector before supplying said pitch codevector for calculation of said pitch prediction error of said at least one signal path; and

c) comparing the pitch prediction errors calculated in said at least two signal paths, choosing the signal path having the lowest calculated pitch prediction error, and selecting the set of pitch codebook parameters associated to the chosen signal path.

11. (PREVIOUSLY PRESENTED) A pitch analysis method as defined in claim 10, wherein, in one of said at least two signal paths, no filtering of the pitch codevector is performed before supplying said pitch codevector to a pitch prediction error calculating device.

12. (PREVIOUSLY PRESENTED) A pitch analysis method as defined in claim 10, wherein said signal paths comprise a plurality of signal paths and wherein filtering the pitch codevector is performed in each of said plurality of

signal paths before supplying said pitch codevector to the pitch prediction error calculating device of the same signal path.

13. (PREVIOUSLY PRESENTED) A pitch analysis method as defined in claim 12, further comprising selecting the filters of said plurality of signal paths from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

14. (ORIGINAL) A pitch analysis method as defined in claim 10, wherein calculating a pitch prediction error in each signal path comprises:

a) convolving the pitch codevector with a weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) calculating a pitch gain in response to the convolved pitch codevector and a pitch search target vector;

c) multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

15. (ORIGINAL) A pitch analysis method as defined in claim 14, wherein said pitch gain calculation comprises calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

16. (PREVIOUSLY PRESENTED) A pitch analysis method as defined in claim 10, wherein calculating said pitch prediction error, in each signal path, comprises calculating an energy of the corresponding pitch prediction error, and wherein comparing the pitch prediction errors comprises comparing the energies of said pitch prediction errors of the different signal paths and choosing as the signal path having the lowest calculated pitch prediction error the signal path having the lowest calculated energy of the pitch prediction error.

17. (ORIGINAL) A pitch analysis method as defined in claim 14, wherein:

a) identifying each of said filters of the plurality of signal paths by a filter index;

b) identifying said pitch codevector by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

18. (ORIGINAL) A pitch analysis method as defined in claim 10, wherein filtering of the pitch codevector is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.

19. (PREVIOUSLY PRESENTED) An encoder having a pitch analysis device as in claim 1 for encoding a wideband input signal, said encoder comprising:

a) a linear prediction synthesis filter calculator responsive to the wideband signal for producing linear prediction synthesis filter coefficients;

b) a perceptual weighting filter, responsive to the wideband signal and the linear prediction synthesis filter coefficients, for producing a perceptually weighted signal;

c) an impulse response generator responsive to said linear prediction synthesis filter coefficients for producing a weighted synthesis filter impulse response signal;

d) a pitch search unit for producing pitch codebook parameters, said pitch search unit comprising:

i) said pitch codebook search device responsive to the perceptually weighted signal and the linear prediction synthesis filter coefficients for producing the pitch codevector and an innovative search target vector; and

ii) said pitch analysis device responsive to the pitch codevector for selecting, from said sets of pitch codebook parameters, the set of pitch codebook parameters associated to the signal path having the lowest calculated pitch prediction error;

e) an innovative codebook search device, responsive to a weighted synthesis filter impulse response signal, and the innovative search target vector, for producing innovative codebook parameters; and

f) a signal forming device for producing an encoded wideband signal comprising the set of pitch codebook parameters associated to the signal path having the lowest pitch prediction error, said innovative codebook parameters, and said linear prediction synthesis filter coefficients.

20. (PREVIOUSLY PRESENTED) An encoder as defined in claim 19, wherein one of said at least two signal paths comprises no filter for filtering the

pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device.

21. (PREVIOUSLY PRESENTED) An encoder as defined in claim 19, wherein said signal paths comprise a plurality of signal paths each provided with a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of the same signal path.

22. (PREVIOUSLY PRESENTED) An encoder as defined in claim 21, wherein the filters of said plurality of signal paths are selected from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

23. (ORIGINAL) An encoder as defined in claim 19, wherein each pitch prediction error calculating device comprises:

a) a convolution unit for convolving the pitch codevector with the weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) a pitch gain calculator for calculating a pitch gain in response to the convolved pitch codevector and a pitch search target vector;

c) an amplifier for multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) a combiner circuit for combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

24. (ORIGINAL) An encoder as defined in claim 23, wherein said pitch gain calculator comprises a means for calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

25. (ORIGINAL) An encoder as defined in claim 19, wherein said pitch prediction error calculating device of each signal path comprises means for calculating an energy of the corresponding pitch prediction error, and wherein said selector comprises means for comparing the energies of said pitch prediction errors of the different signal paths and for choosing as the signal

path having the lowest calculated pitch prediction error the signal path having the lowest calculated energy of the pitch prediction error.

26. (ORIGINAL) An encoder as defined in claim 23, wherein:

a) each of said filters of the plurality of signal paths is identified by a filter index;

b) said pitch codevector is identified by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

27. (ORIGINAL) An encoder as defined in claim 19, wherein said filter is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.

28. (PREVIOUSLY PRESENTED) A cellular communication system for servicing a geographical area divided into a plurality of cells, comprising:

a) mobile transmitter/receiver units;

b) cellular base stations respectively situated in said cells;

c) a control terminal for controlling communication between the cellular base stations; and

d) a bidirectional wireless communication sub-system between each mobile unit situated in one cell and the cellular base station of said one cell, said bidirectional wireless communication sub-system comprising, in both the mobile unit and the cellular base station:

i) a transmitter including an encoder for encoding a wideband signal as recited in claim 19, and a transmission circuit for transmitting the encoded wideband signal; and

ii) a receiver including a receiving circuit for receiving a transmitted encoded wideband signal and a decoder for decoding the received encoded wideband signal.

29. (PREVIOUSLY PRESENTED) A cellular communication system as defined in claim 28, wherein one of said at least two signal paths comprises no filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device.

30. (PREVIOUSLY PRESENTED) A cellular communication system as defined in claim 28, wherein said signal paths comprise a plurality of signal paths each provided with a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of the same signal path.

31. (PREVIOUSLY PRESENTED) A cellular communication system as defined in claim 30, wherein the filters of said plurality of signal paths are selected from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

32. (ORIGINAL) A cellular communication system as defined in claim 28, wherein each pitch prediction error calculating device comprises:

a) a convolution unit for convolving the pitch codevector with the weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) a pitch gain calculator for calculating a pitch gain in response to the convolved pitch codevector and the pitch search target vector;

c) an amplifier for multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) a combiner circuit for combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

33. (ORIGINAL) A cellular communication system as defined in claim 32, wherein said pitch gain calculator comprises a means for calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

34. (ORIGINAL) A cellular communication system as defined in claim 28, wherein said pitch prediction error calculating device of each signal path comprises means for calculating an energy of the corresponding pitch prediction error, and wherein said selector comprises means for comparing the energies of said pitch prediction errors of the different signal paths and for choosing as the signal path having the lowest calculated pitch prediction error the signal path having the lowest calculated energy of the pitch prediction error.

35. (ORIGINAL) A cellular communication system as defined in claim 32, wherein:

a) each of said filters of the plurality of signal paths is identified by a filter index;

b) said pitch codevector is identified by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

36. (ORIGINAL) A cellular communication system as defined in claim 28, wherein said filter is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.

37. (ORIGINAL) A cellular mobile transmitter/receiver unit, comprising:

a) a transmitter including an encoder for encoding a wideband signal as recited in claim 19 and a transmission circuit for transmitting the encoded wideband signal; and

b) a receiver including a receiving circuit for receiving a transmitted encoded wideband signal and a decoder for decoding the received encoded wideband signal.

38. (PREVIOUSLY PRESENTED) A cellular mobile transmitter/receiver unit as defined in claim 37, wherein one of said at least two signal paths

comprises no filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device.

39. (PREVIOUSLY PRESENTED) A cellular mobile transmitter/receiver unit as defined in claim 37, wherein said signal paths comprise a plurality of signal paths each provided with a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of the same signal path.

40. (PREVIOUSLY PRESENTED) A cellular mobile transmitter/receiver unit as defined in claim 39, wherein the filters of said plurality of signal paths are selected from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

41. (ORIGINAL) A cellular mobile transmitter/receiver unit as defined in claim 37, wherein each pitch prediction error calculating device comprises:

a) a convolution unit for convolving the pitch codevector with the weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) a pitch gain calculator for calculating a pitch gain in response to the convolved pitch codevector and a pitch search target vector;

c) an amplifier for multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) a combiner circuit for combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

42. (ORIGINAL) A cellular mobile transmitter/receiver unit as defined in claim 41, wherein said pitch gain calculator comprises a means for calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

43. (ORIGINAL) A cellular mobile transmitter/receiver unit as defined in claim 37, wherein said pitch prediction error calculating device of each signal path comprises means for calculating an energy of the corresponding pitch prediction error, and wherein said selector comprises means for comparing the energies of said pitch prediction errors of the different signal paths and for choosing as the signal path having the lowest calculated pitch

prediction error the signal path having the lowest calculated energy of the pitch prediction error.

44. (ORIGINAL) A cellular mobile transmitter/receiver unit as defined in claim 41, wherein:

a) each of said filters of the plurality of signal paths is identified by a filter index;

b) said pitch codevector is identified by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

45. (ORIGINAL) A cellular mobile transmitter/receiver unit as defined in claim 37, wherein said filter is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.

46. (PREVIOUSLY PRESENTED) A network element, comprising:

a transmitter including an encoder for encoding a wideband signal as recited in claim 19 and a transmission circuit for transmitting the encoded wideband signal.

47. (PREVIOUSLY PRESENTED) A network element as defined in claim 46, wherein one of said at least two signal paths comprises no filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device.

48. (PREVIOUSLY PRESENTED) A network element as defined in claim 46, wherein said signal paths comprise a plurality of signal paths each provided with a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of the same path.

49. (PREVIOUSLY PRESENTED) A network element as defined in claim 48, wherein the filters of said plurality of paths are selected from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

50. (PREVIOUSLY PRESENTED) A network element as defined in claim 46, wherein each pitch prediction error calculating device comprises:

a) a convolution unit for convolving the pitch codevector with the weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) a pitch gain calculator for calculating a pitch gain in response to the convolved pitch codevector and a pitch search target vector;

c) an amplifier for multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) a combiner circuit for combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

51. (PREVIOUSLY PRESENTED) A network element as defined in claim 50, wherein said pitch gain calculator comprises a means for calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

52. (PREVIOUSLY PRESENTED) A network element as defined in claim 46, wherein said pitch prediction error calculating device of each signal path comprises means for calculating an energy of the corresponding pitch prediction error, and wherein said selector comprises means for comparing the

energies of said pitch prediction errors of the different signal paths and for choosing as the signal path having the lowest calculated pitch prediction error the signal path having the lowest calculated energy of the pitch prediction error.

53. (PREVIOUSLY PRESENTED) A network element as defined in claim 50, wherein:

a) each of said filters of the plurality of signal paths is identified by a filter index;

b) said pitch codevector is identified by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

54. (PREVIOUSLY PRESENTED) A network element as defined in claim 46, wherein said filter is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.

55. (PREVIOUSLY PRESENTED) In a cellular communication system for servicing a geographical area divided into a plurality of cells, comprising: mobile transmitter/receiver units, cellular base stations respectively situated in said cells; and a control terminal for controlling communication between the

cellular base stations; a bidirectional wireless communication sub-system between each mobile unit situated in one cell and the cellular base station of said one cell, said bidirectional wireless communication sub-system comprising, in both the mobile unit and the cellular base station:

a) a transmitter including an encoder for encoding a wideband signal as recited in claim 19, and a transmission circuit for transmitting the encoded wideband signal; and

b) a receiver including a receiving circuit for receiving a transmitted encoded wideband signal and a decoder for decoding the received encoded wideband signal.

56. (PREVIOUSLY PRESENTED) A bidirectional wireless communication sub-system as defined in claim 55, wherein one of said at least two signal paths comprises no filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device.

57. (PREVIOUSLY PRESENTED) A bidirectional wireless communication sub-system as defined in claim 55, wherein said signal paths comprise a plurality of signal paths each provided with a filter for filtering the pitch codevector before supplying said pitch codevector to the pitch prediction error calculating device of the same signal path.

58. (PREVIOUSLY PRESENTED) A bidirectional wireless communication sub-system as defined in claim 57, wherein the filters of said plurality of signal paths are selected from the group consisting of low-pass and band-pass filters, and wherein said filters have different frequency responses.

59. (ORIGINAL) A bidirectional wireless communication sub-system as defined in claim 55, wherein each pitch prediction error calculating device comprises:

a) a convolution unit for convolving the pitch codevector with the weighted synthesis filter impulse response signal and therefore calculating a convolved pitch codevector;

b) a pitch gain calculator for calculating a pitch gain in response to the convolved pitch codevector and a pitch search target vector;

c) an amplifier for multiplying the convolved pitch codevector by the pitch gain to thereby produce an amplified convolved pitch codevector; and

d) a combiner circuit for combining the amplified convolved pitch codevector with the pitch search target vector to thereby produce the pitch prediction error.

60. (ORIGINAL) A bidirectional wireless communication sub-system as defined in claim 59, wherein said pitch gain calculator comprises a means for calculating said pitch gain $b^{(j)}$ using the relation:

$$b^{(j)} = x^t y^{(j)} / \left\| y^{(j)} \right\|^2$$

where j = 0, 1, 2, ... , K, and K corresponds to a number of signal paths, and where x is said pitch search target vector and $y^{(j)}$ is said convolved pitch codevector.

61. (ORIGINAL) A bidirectional wireless communication sub-system as defined in claim 55, wherein said pitch prediction error calculating device of each signal path comprises means for calculating an energy of the corresponding pitch prediction error, and wherein said selector comprises means for comparing the energies of said pitch prediction errors of the different signal paths and for choosing as the signal path having the lowest calculated pitch prediction error the signal path having the lowest calculated energy of the pitch prediction error.

62. (ORIGINAL) A bidirectional wireless communication sub-system as defined in claim 59, wherein:

a) each of said filters of the plurality of signal paths is identified by a filter index;

b) said pitch codevector is identified by a pitch codebook index; and

c) said pitch codebook parameters comprise the filter index, the pitch codebook index and the pitch gain.

63. (ORIGINAL) A bidirectional wireless communication sub-system as defined in claim 55, wherein said filter is integrated in an interpolation filter of said pitch codebook search device, said interpolation filter being used to produce a sub-sample version of said pitch codevector.